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ABSTRACT

The study attempted to determine: (1) whether achievement in the early school years is related to anxiety and curiosity in later school years; and (2) whether anxiety and curiosity in early school years are related to achievement in later school years. The Stafford Achievement Test (SAT), the Children's Manifest Anxiety Scale (CMAS), and the Children's Reactive Curiosity Scale (RCS) were used to pre- and post-test 73 boys and girls in a traditional, structured school, and 74 boys and girls in an innovative, unstructured school. Procedures and statistical analyses of data are included. Results indicate that there is a significant correlation between fourth grade anxiety and sixth grade achievement for boys in the traditional school, and between fourth grade curiosity and sixth grade achievement for girls in the traditional school. No other significant correlations were found. Discussion focuses on possible explanations. (TL)

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ABSTRACT

Samples of students in the fourth grades of innovative and traditional schools were administered the Children's Manifest Anxiety Scale (CMAS), the Reactive Curiosity Scale (RCS), and the Stanford Achievement Tests (SAT). Two years later, the tests were again administered to the samples. Canonical correlations were used to determine whether RCS and CMAS are antecedent variables of achievement or if the converse is true. In both schools, RCS and CMAS are antecedents of achievement, and the converse relationship is not true. The significant canonical relationships reveal for boys: there is a negative relationship between CMAS and achievement; a positive relationship between RCS and achievement. For girls, these relationships are reversed.

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Introduction

Of the many classroom variables affecting learning that have been studied in the past decade, anxiety and curiosity have been of primary importance to investigators. These two ~~variables~~ have been studied in relation to numerous other human characteristics. In an exhaustive review of the literature on the subject, Ruebush (18) has found that the interpretation of findings from different investigators are complicated by differences in theoretical orientation and by differences in operational criteria. Also, many of the studies have been done in such tightly controlled experimental environments that it is extremely difficult to generalize the findings to new situations.

Several researchers have found relationships to exist between anxiety, curiosity, and subjects' academic performance under varying sets of circumstances. With few exceptions, however, researchers have concerned themselves with only one of the psychological variables (anxiety, curiosity) at a time. Berlyne (1,2), Greenberger et al (9), and Lucco (13) have developed experimental environments in which subjects' levels of curiosity have been controlled and have in turn influenced subjects' performance on learning tasks. Sassenrath (19), White and Aaron (22), Rosenthal (17), and Knight and Sassenrath (11) have shown that relationships between subjects' anxiety and performance on learning tasks are similar to the relationship between subjects' curiosity and performance on learning tasks. Also, the relationship between anxiety, curiosity and a subject's academic performance is different for boys than for girls. Lucco (13) and White et al (22) have shown that significant differences

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exist between boy and girl subjects' performance on learning tasks when they are carried out under varying levels of anxiety and curiosity. In general, the investigators of anxiety and curiosity have shown low, positive correlations between subjects' learning task performance and the two psychological variables. There is reason to believe, however, that if anxiety and curiosity are considered simultaneously, that relationships heretofore unrecognized will emerge.

The object of this study is to determine: 1) whether achievement in the early school years is related to anxiety and curiosity in later school years, and 2) whether anxiety and curiosity in the early school years are related to achievement in later school years. Relationships between these measures will be considered in two different classroom environments over a two year period.

The Sample

The sample for this study consisted of 147 subjects on whom complete data were available on completion of the study. Seventy-three (33 boys, 30 girls) were students in what will be described as a traditional school, and 74 (37 boys, 37 girls) were students in an innovative school. These two groups consisted of 98 and 93 students respectively at the beginning of the study. Expected student attrition, absence during testing, and a change in school attendance areas were responsible for the reduced sample size. None of the available evidence on factors responsible for the reduced sample size indicates that the sample was biased. The traditional school-group experienced a relatively locked-step-single-teacher situation.

The innovative group experienced a multiple teacher, individualized work-at-your-own-rate situation. In the past, the students from the two schools had similar performance records. The socio-economic levels of the two areas of the community from which the students were drawn were judged by the investigator to be comparable.

Procedures

To evaluate student achievement, the samples were given the Stanford Achievement Tests (SAT) - Intermediate I at the beginning of the study and Intermediate II at the end. The subtests common to both were: 1) Word Meaning, 2) Paragraph Meaning, 3) Spelling, 4) Language, 5) Arithmetic Computation, 6) Arithmetic Concepts, 7) Arithmetic Application, 8) Social Studies, and 9) Science. The tenth subtest for Intermediate I was Word Study Skills, and for Intermediate II it was Modern Math Concepts. These subtest scores were considered separately in the analysis.

The instrument utilized in this study to determine the level of anxiety measures manifest anxiety and therefore dictates the construct. It was ostensibly developed to measure different aspects of drive (D) in order to relate anxiety as a possible D to learning. Spence (20) suggested that manifest anxiety, as an aspect of D, multiplies all learned habits (H) that are elicited in a situation. He stated that the higher the D the higher the excitatory potential (E), and the greater the strength of all elicited responses (R) in that situation, i.e., $D \times H = E \rightarrow R$.

Take for example a subject who performs a task while not anxious, but at another time performs the same task while anxious. The new situation, in which anxiety is aroused, would be viewed in this theory mainly from the

characteristic of anxiety as a drive to increase the excitatory potential of all responses already present (habits) in the situation. With the heightened E, the intensity of the response made by a subject would be stronger than if the anxiety were not present.

The Children's Manifest Anxiety Scale (CMAS) (3) was used to determine the levels of manifest anxiety at both the beginning and the end of the study. The scale contains 53 items to which subjects responded yes or no. Forty-two of these items were used as a part of a subject's score. The total number of yes answers is a subject's score, with a higher number indicating higher levels of anxiety. The 11 remaining questions were randomly placed in the test and used to check the tendency of respondents to falsify answers.

The Children's Reactive Curiosity Scale (RCS) (15) was used to determine the level of reactive curiosity at both the beginning and the end of the study. The scale contains 100 items - 90 of which are used as a part of a subject's score, and 10 to check the respondent's tendency to falsify responses. These 10 lie items were randomly placed in the test.

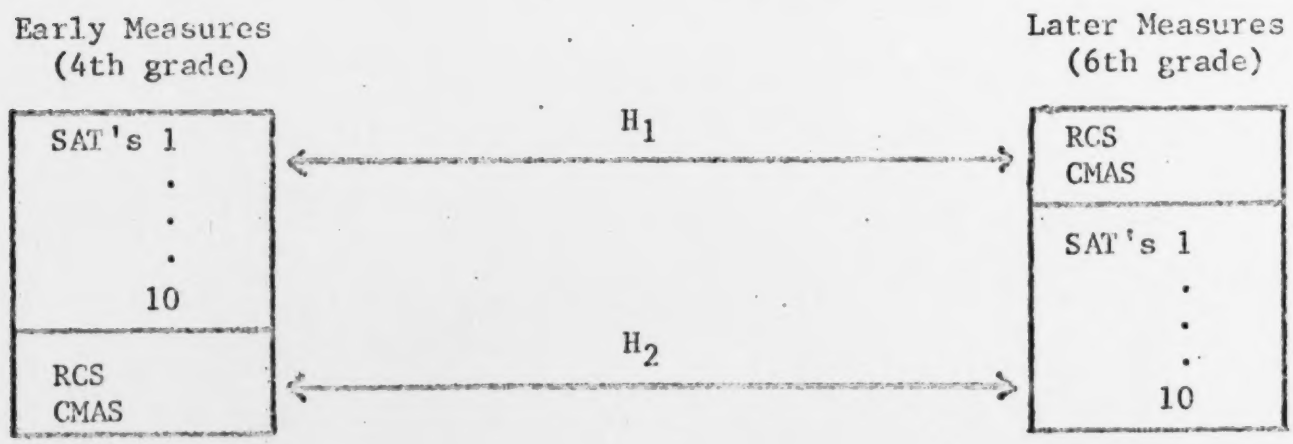
Curiosity, for purposes of this study, is reactive curiosity and is defined as: 1) a tendency to approach and explore relatively new stimulus situations, 2) a tendency to approach and explore incongruous complex stimuli, and 3) a tendency to vary stimulation in the presence of frequently experienced stimulations (15).

The initial or pre-data were gathered in May, 1966. At this time, students in both schools completed the RCS, CMAS, and the ten subtests of the SAT Intermediate I. Students were at this time nearing completion of

their fourth year of school. In May, 1968, when students were nearing completion of their sixth year of school, the final, or post-data, were gathered. Both groups again completed the RCS and CMAS. At this time, they also completed the ten subtests of the SAT Intermediate II.

Canonical correlations (10) were used as a test for the two parts of the objective of this study. In this technique, an investigator is able to express, in a single index, the relationship (canonical correlation, Rc) between two sets of weighted linear composites of variables. For the test of the first half of the objective (Are later levels of reactive curiosity and manifest anxiety a function of early levels of achievement?), the 10 pre-SAT subtest scores were used as one set of variables and the post CMAS and RCS scores served as the other. In testing for the second half of the objective (Are later levels of achievement a function of early levels of reactive curiosity and manifest anxiety?), the pre-RCS and CMAS scores were used as one set of variables and the post-SAT subtest scores served as the other. In Figure 1, the line labeled H_1 represents the relationship tested for in the first half of the objective while the line labeled H_2 represents the relationship tested for in the second half of the objective. Separate analyses (as shown in Figure 1) were performed for each school.

Figure 1. Experimental Design



Results

Tables 1 and 2 contain the Rc's with their associated chi-square, degrees of freedom, and probability level.[1] The Rc's and probabilities of Table 1 indicate that no significant canonical relationships exist between the pre-SAT subtests and the post-RCS and CMAS scores. That is, for both schools, there is no way in which the pre-SAT subtest scores and the post-RCS and CMAS scores can be weighted so that the linear composites of each of the two sets of variables have a significant correlation.

Table 1. CANONICAL CORRELATIONS
(Pre SAT's, Post RCS and CMAS)

	Rc	X^2	Deg.Fre.	Prob.
Traditional School	.37	10.1	11	.52
Innovative School	.38	10.9	11	.54

Table 2. CANONICAL CORRELATIONS
(Pre RCS and CMAS, Post SAT's)

	Rc	X^2	Deg.Fre	Prob.
Traditional School	.52	21.3	11	.03
Innovative School	.51	21.0	11	.03

The pre-RCS and CMAS scores and the post-SAT subtest scores yielded one significant canonical relationship for each school. In both the innovative and in the traditional schools, the first set of weights yielded a

Rc of .52. The Rc obtained from the second set of weights for each school was non-significant. For each school, there was one distinct way in which the post-SAT subtest scores and pre-RCS and CMAS scores could be weighted so that the linear composites of the two sets of variables were significantly correlated.

With canonical correlations, the factor loadings can be used to indicate the relative contribution of each variable to the canonical relationship. Factor loadings are the correlations between the original student scores and their weighted composite. A factor loading is calculated for each variable on each canonical root. If more than one canonical root is extracted, a new set of factor loadings is calculated for each (21).

Table 3. FACTOR LOADINGS

Variable		Innovative School	Traditional School
SAT's	1	.00	.48
	2	.47	.51
	3	.12	.74
	4	.26	.53
	5	.06	.47
	6	.34	.05
	7	.32	.34
	8	-.02	.38
	9	.04	.36
	10	.14	.17
	RCS	.75	.83
	CMAS	.68	-.47

A comparison of the factor loadings associated with each of the significant Rc's (Table 3) reveals that they have different patterns. That is, the values of the factor loadings for the individual variables is different for each school. These pattern differences may be due to: School classroom

environment, individual student abilities, or home environments. Despite these pattern differences, the relationships between the two psychological variables and the achievement variables within each school does exist. A comparison of the two schools on each of the variables (F tests) showed only small differences. Therefore, it may be assumed that the pattern differences arose from underlying relationships that exist between these variables within each school.

The boys' and girls' pre-RCS and CMAS scores and post-SAT subtest scores of each school were submitted to a canonical analysis in an attempt to determine the origin of the significant relationships discussed above. Table 4 contains the Rc's, chi-squares, degrees of freedom, and probability statements of the boys' and girls' sections for each of the schools.

Table 4. CANONICAL CORRELATIONS
(Pre RCS and CMAS, Post SAT's)
(Boys and girls separated)

	Rc	X^2	Deg.Fre.	Prob.
Traditional School (Boys)	.73	20.6	11	.03
Traditional School (Girls)	.66	19.9	11	.04
Innovative School (Boys)	.58	12.8	11	.30
Innovative School (Girls)	.66	17.5	11	.09

Neither the boys' nor the girls' sections of the innovative school yielded any significant ($P<.05$) canonical relationships. That is, there was no way in which these variables could be weighted so that the linear composites of the two sets were correlated.

The Rc for the boys' section of the traditional school was .73. For the girls' section of the traditional school, the Rc was .66. The Rc's obtained from the second set of weights for neither the boys' nor the girls' group was significant. There was one way in which the variables of the boys' section of the traditional school could be weighted so that the linear composites of the two sets of variables were correlated. Also, there was one set of weights that yielded a significant correlation when applied to the girls' scores.

Table 2. FACTOR LOADINGS
(Traditional school - Boys and girls separated)

Variable		Boys	Girls
SAT's	1	-.45	.56
	2	-.28	.58
	3	-.16	.47
	4	-.10	.57
	5	-.37	.30
	6	-.06	.25
	7	-.37	.21
	8	-.19	.41
	9	-.15	.69
	10	-.21	.12
	RCS	-.11	.99
	CMAS	.98	.16

Table 5 contains the factor loadings of the boys' and girls' sections of the traditional school. Only the factor loadings associated with significant sets of weights were included. The factor loadings for the boys' SAT's ranged from -.06 to -.42, and for the girls' ranged from .13 to .69. The factor loadings of RCS and CMAS were -.12 and .98 for the boys and .99 and .17 for the girls, respectively. The factor loadings indicate that for boys and girls the role of RCS and CMAS as contributors to the canonical

relationship are reversed. That is, when the factor loading of one of the psychological variables is large for one sex, it is small for the other.

Multiple correlations (R) between each of the psychological variables and the 10 SAT subtests of the boys' and girls' sections of the traditional school (Table 6) verify the factor loadings discussed in the preceding paragraph. For boys, the 10 SAT subtests account for 24% and 53% of the variance of the RCS and CMAS scores respectively. For girls, the 10 SAT subtests account for 45% and 28% of the variance of the RCS and CMAS scores respectively. The R's indicate that the relationship of the two psychological variables to the 10 SAT subtests is reversed for the two sexes. For boys, a significant R was found between the 10 SAT subtests and CMAS, but not the RCS. For girls, a significant R was found between the 10 SAT subtests and RCS, but not the CMAS.

Table 6. MULTIPLE CORRELATIONS BETWEEN RCS AND SAT's, CMAS AND SAT's.

Variables	R	R^2	Prob.
Traditional School Boys			
RCS & SAT's	.49	.24	.57
CMAS & SAT's	.73	.53	.01
Traditional School Girls			
RCS & SAT's	.67	.45	.01
CMAS & SAT's	.53	.28	.26

A limitation of canonical correlations (8:350) is that they will tend to capitalize excessively on any high correlation between a variable in one set and a variable in the other. In such a situation, the Rc obtained will

be spuriously high because the highly correlated variables will receive high weights, and other variables will be weighted in such a way as to maximize this relationship. Inspection of the cross-correlation matrix to determine whether any inordinantly high correlations exist between variables of the two sets will identify occurrence of this limitation.

The cross-correlation matrices yielding significant Rc's were inspected and all values were found to be relatively low. The median absolute cross-correlations and ranges were: traditional school with boys and girls combined, .15, .32 to -.22; innovative school with boys and girls combined, .08, .25 to -.09; girls' section of traditional school, .10, .15 to -.32. Since none of the cross-correlations were inordinantly high, it is assumed that the significant canonical relationships found were a result not of one or two variables in each set, but of some larger portion of the total set.

Discussion

Significant Rc's were found to exist between the fourth grade RCS and CMAS scores and the sixth grade SAT subtest scores. No significant Rc's were found to exist between these variables when they were collected in the reverse time sequence. These findings indicate that achievement levels in later years are a function of manifest anxiety and reactive curiosity levels in earlier years, and that the converse of the relationship is not true. This relationship between the variables holds true when a student is taught in an "individualized" or a "traditional" classroom environment. These findings satisfy the two parts of the original objective of the study.

The relationship of fourth grade RCS and CMAS scores and sixth grade SAT scores for the boys and the girls in each of the two schools is not as

easily explained as was the original objective of this study. In the traditional school, but not the innovative school, significant Rc's were found to exist between the fourth grade RCS and CMAS scores, and the sixth grade SAT subtest scores for both the boys and girls. The differences of the results in the two school settings may be explained either on the basis of the statistical procedures utilized, or the environment in which students worked. Statistically, even though the same number of degrees of freedom are used in deriving the Rc, chi-square is the test of significance. By cutting the sample size approximately in half (half boys and half girls), chi-square (which is equal to the sum of Z^2) is reduced. This in turn, reduces the probability of reaching significance under a given set of circumstances. If the relationship between the variables existed in both school settings, but was "less strong" for the innovative school, reducing the size of the sample may have allowed the non-significant statistical results.

In terms of the learning environment, Knight et al (11) have shown that students with average to high levels of anxiety show greater achievement in more highly structured than unstructured learning environments. Berlyne (1) has reported that the amount of exploratory behavior (curiosity) exhibited by a child is a function of the complexity of the environment in which he is working. The influence of these two psychological variables in learning is a direct function of the structure and complexity of the learning environment in which a student works. The innovative school purposely developed an unstructured environment, and the environment of the traditional school was more structured. The environmental difference is then expected to generate different relationships between anxiety, curiosity, and

achievement which in turn are reflected as differences in the canonical relationships.

For the boys of the traditional school, fourth grade anxiety was related to sixth grade achievement, and fourth grade curiosity was not related to sixth grade achievement. More specifically, manifest anxiety had a high negative relationship to achievement, and reactive curiosity had a low positive relationship to achievement. For example, a boy in fourth grade with a high level of manifest anxiety would tend to score lower on achievement tests in sixth grade than a boy who in fourth grade had low manifest anxiety. A boy's fourth grade reactive curiosity score, on the other hand, has little or no predictive validity for his sixth grade achievement scores.

For girls of the traditional school, early levels of reactive curiosity had a high positive relationship to later achievement, and early levels of manifest anxiety had only a low positive relationship to later achievement. For example, a girl in fourth grade with high reactive curiosity would tend to score higher on an achievement test in sixth grade than a girl who in fourth grade had low reactive curiosity. A girl's fourth grade manifest anxiety score, on the other hand, has little or no predictive validity for her sixth grade achievement scores.

The relationship between anxiety, curiosity and achievement is obviously different for boys than for girls. This investigator has been unable to develop an argument that he feels satisfactorily explains the differences in the relationship of these variables for the two sexes. The explanation of why the variables are related in the ways that they are evidently lies in continued experimentation. There is, however, a literature that may

serve as a guide to continued, profitable experimentation. Factors such as growth and maturation have been advanced as explanations for differences in boys' and girls' achievements (4,5,12). Elements of the general culture, expectations, and attitudes have been suggested as producing boy - girl achievement differences by Dechant (6), Gates (7), and Preston (16). Others (14) believe that differences in boy - girl achievement and attitudes may be a function of the way in which students react to what is essentially the "feminine" atmosphere of the elementary school classroom. These are but a few of the studies in this area that may serve as a guide in continued experimentation.

In summary, reactive curiosity and manifest anxiety when considered simultaneously are antecedent variables to achievement. The relationship between the two psychological variables and achievement is, however, different for boys than for girls. Manifest anxiety has a high negative relationship to achievement for boys and only a small positive relationship to achievement for girls. Reactive curiosity has a high positive relationship to achievement for girls and only a small positive relationship to achievement for boys.

FOOTNOTES

1 Canonical correlations and their associated values were calculated by a computer program written by M. Yost and E. F. Hughes. "Complete Canonical Solutions on Small Computers," Behavioral Science, In Press.

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